

Project Opportunity: Philippines

Rehabilitation and Hybridization of Solar Plant on Pangan-an Island

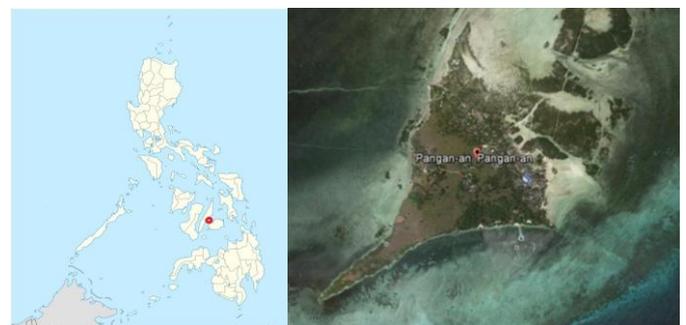
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This factsheet describes a specific project opportunity in hybridizing community diesel-grids in the Philippines and is intended to provide project developers with the most relevant information to access a suitability of the project for own development activities as well as fostering general knowledge on typical site conditions on smaller Philippian islands. Pangan-an island is a barangay of Lapu-Lapu City, Cebu in the central Visayas, Philippines. The island has a population of 375 households. Main economic activities are fishing, tourism, and shell craft making. A 45kWp solar power plant was installed in 1998 in cooperation with the Belgian government, the Philippine Department of Energy and the local government of Lapu-Lapu City. The power plant provided the island with 24 hours of electricity; the operation was managed by the Pangan-an Island Cooperative for Community Development (PICCD). The system is not operational anymore and will be turned over to Mactan Electric Company (MECO) for rehabilitation.

I. Project Opportunity

Pangan-an Island was one of the early showcases for a solar power plant that provided 24 hours of electricity to power the economic activities of a community in central Visayas. PICCD was organized and trained to operate and manage the system. With support from the Department of Energy Visay as Field Office, PICCD was able to build their fund of over a million pesos through the operation and collection of payments from the consumers. The batteries and most of the solar modules failed after more than twenty five years of operation. The system will be turned over to MECO that is planning to rehabilitate and hybridize the system with the latest energy storage technology.



Location of Pangan-an Island, Cebu Province, Philippines
Source: Google Inc.: Google earth, August 2016 (C. N10.21999 E124.03891)

2. General Information

Pangan-an Island can be reached from Manila with an hour flight to Mactan, Cebu, with a 30 minute land travel to the port in Cordova and a 30 minute pump boat ride to the island. Boat travel is slower during low tide in approaching Pangan-an Island with shallow waters within 2 km from the shore. Seas are rough in the “Habagat” season from June to November. Pump boats have a capacity for 15 persons.

This island has a population of 375 persons with an average household size of 4.5 and an annual population growth rate of 2.94%. About 46% of the population is more than 18 years old. The economic activities on the island are mainly fishing, tourism, and shell craft making for souvenir shops in Cebu and for export. The regional average annual household income is PHP 209,000; average annual household expenditure is PHP 164,000.

3. Energy Situation

The island’s electricity needs used to be served by a 45kWp solar power plant installed by the Kingdom of Belgium and the Philippine Department of Energy with the Local Government of Lapu-Lapu City. The island is under the franchise area of Mactan Electric Company (MECO) that provides electricity service for the main island of Mactan and the smaller islands of Olanggo using diesel generators.

The solar power plant is composed of 504 pieces of 90Wp solar modules, 118 pieces of 2V 1800AH lead acid batteries, charge controllers, inverters, and a low voltage distribution system. The estimated cost of the system was PHP 22 million. The average monthly demand in the years 1999 to 2003 was 1,500 kWh which grew to 1,870 kWh in 2004 and 2005. Out of the 375 households on the island, 247 were connected in 2011.

The electricity tariff is decided by PICCD in consultation with its consumers and assistance from DOE. The initial tariff was set at a fixed monthly fee of PHP 210 with a minimum 9 kWh consumption. The succeeding kWh is charged at PHP 30/kWh. The following year till 2002 the minimum demand was reduced to 7 kWh for a fixed fee of P150 monthly, and PHP 30/kWh for the succeeding demand. The rates were changed in 2003 to a minimum demand of 9 kWh with a lower fixed fee of PHP 110 and a reduced PHP 23/kWh for the succeeding kWh demand. In 2007, the tariff was further reduced to a fixed minimum fee of PHP 50 for the first 3 kWh and PHP 15/kWh for the succeeding demand.

In 2011 the solar power plant stopped functioning. Based on the assessment of the Department of Energy Visayas Field Office (DOE VFO), it needs full replacement of the battery bank and 150 pieces of solar modules: an investment of at least PHP 6 million. With the lack of capital, PICCD decided to purchase a diesel generator to be

able to continue providing power to the community. Their operating cost tripled. Currently, expenditure for fuel is higher than the revenues collected. DOE has recommended to hand-over the power plant to MECO for rehabilitation and for its operation.

Mobile cellular service is available from major providers like Globe, Smart, and Sun Cellular. The signal is good due to the proximity to Mactan Island. Radios receive local AM and FM stations. Commercial TV reception is good from ABS-CBN and GMA networks.

There is basic infrastructure on the island such as elementary schools and health centers. Roads, mainly used by bicycles and motor cycles, are mostly dirt and sand. Pangan-an Island belongs to the Olanggo group of seven islands. A concrete path was constructed to connect Olanggo Island to Pangan-an which is accessible during low tide when the water is too shallow for boats to cross the channel. Potable water is hauled in plastic containers by boat from Mactan Island.



Shell craft making in Pangan-an Island.

Key Facts and Figures

Location	Pangan-an Island , Lapu-lapu City, Cebu Province, Central Visayas (Region VII) Philippines
Population	375 households (HH)
Land area	0.6 km²
Economic activities	Fishing , tourism, shell craft making
Distribution Utility coverage area	Mactan Electric Company
Existing power supply	45 kWp Solar Power Plant with battery, operating for 24 hours a day , Not operational since 2011 due to defective batteries and PV modules
Fuel Cost	PHP 37.55liter (€0.72/litre) retail price at gas station in Mactan, Cebu
Electricity tariff	PHP 15.00/kWh (€0.29/kWh) set by PICCD
Solar radiation data	5.29 (kWh/m²/year) National Renewable Energy Laboratory
Wind average speed (m/s)	4.21m/s (at hub height of 50m,Source: NREL1982-1993)

Source: Lapu-lapu LGU, M.Baclay DOE VFO, NREL

4. PV-Hybrid Project Design Data

Administration

Distribution utility	MECO
Power generation entity	PICCD
Cost of power generation	Subsidized capital cost
Electricity rate charged to customer (true cost & subsidized)	PHP 15.00/kWh (PICCD)
Power plant upgrading plans	Rehabilitation & hybridization
Average monthly energy sales	1,870kWh/month (DOE 2004)
Billing & collection system	Monthly meter reading, billing and collection by PICCD
Collection efficiency	60%

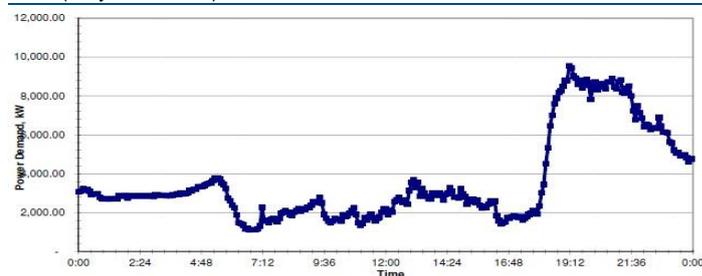
Grid Information

Distribution system type	Single phase, delta/star (wye)
Distribution line (overhead, underground)	3 phase Wye Overhead
Insulation (bare, insulated)	Insulated
Type of pole (wooden, concrete, steel)	25 feet wood pole
Sizes and number of transformers/substations	none
Network configuration (LV only, LV with MV)	LV only
Distribution voltage level (Volts AC)	230
Nominal frequency (50/60Hz)	60
Meter type, brand, model	-
Medium voltage level (kV)	-
MV line configuration (star, 4,5 wire, etc.)	4 wire Wye
Average power factor	0.89 lagging
Power supply service quality	-
Operating hours per day	24 hours
Outages per year (hours/days), Low voltage level (Volts AC)	Defective batteries and PV panels

Operating frequency range (Hz)	60Hz
Single Line Diagram of electrical distribution system	Secondary at 230VAC L-N Wood poles 50 meters apart

Load/Demand

Types and number of customer, energy consumption households	247 HH
Commercial	None
Industrial	None
Government building	school, health center
Water district	None
Streetlights	-
Others	None
Annual energy consumption kWh	22,440 kWh
Load profile/load demand curve	-
Minimum load kWmin	1 kW (6am)
Maximum loadkWmax	10 kW (7pm)
Noon time load kW	None
Seasonal load variations	High demand during fiestas, holidays and special occasions
Electricity demand forecast	25 kW
Household electrification level (% , year of data)	65%



Load Profile/Load Demand Curve

Source: DOE VFO

Diesel Genset Data

Power plant operator/administrator	PICCD/DOE VFO to be transferred to MECO
Year plant operation started	1998
Power plant data	-

Number of gensets	PV Plant
Genset capacities (installed)	90Wp x 504 modules
Genset capacities (dependable)	Inverter output 12.5kW (with master & slave)
Genset output voltage/wire configuration	230 V
Genset operating time	24h availability
Fuel consumption (litres)	0
kWh generation	63 kWh/day (at 10kW peak load)
Genset information/data sheet	-
Genset synchronization (manual/automatic)	Automatic
Genset control (manual/automatic)	Automatic
Fuel type	Solar PV
Annual fuel consumption litres	None
Delivered cost of fuel	Contracted (Retail rate PHP 37.55/litre (€0.72/litre) in Mactan, Cebu)
Fuel source/supplier	None

Hybrid Data

Renewable energy resources: solar radiation Data (kWh/m ² /day)	5.29
Solar data source	NREL
Wind data:	-
Wind average speed (m/s)	4.21
Hub height (m)	50
Period data taken	1982-1993
Wind density (W/m ²)	137
Wind data source	NREL
Ambient temperature	25.91 oC
Data source of temperature	PAGASA
Rainfall data/ precipitation	1260mm/year
Data source of precipitation	PAGASA
Availability of area for solar array	Available
Availability of area for power house	Available
Availability of area for battery bank	Available
Land ownership	Public and private

5. Hybrid Opportunity

6. Proposed Project Setup

The solar power plant and the electricity distribution service will be turned over to MECO which holds the franchise of Pangan-an Island. MECO has the technical and financial capacity to invest in the power plant on the island and manage its operation. Equipment suppliers and service providers for renewable energy technology will be needed by MECO. Possible partner investors and financing will also help to implement the project in utilizing renewable energy sources and the latest energy storage technologies to have an affordable cost of electricity for the community on Pangan-an Island.

The Pangan-an Solar Power Plant was able to show the technical viability of a stand-alone power plant to cover the electricity needs of an island community using photovoltaic and storage technology. PICCS decided to use a diesel generator to supply the island after the service life of the battery and the failing of solar PV modules. The resulting operating cost of PICCD tripped due to the high fuel cost. This resulted in lost business opportunities on the island that used to be powered 24 hours by the solar power plant. There is an opportunity to hybridize the system with the rich solar and wind system.

Resources on the island to have an affordable electricity cost and clean source of power.



Pangan-an Solar Power Plant and low voltage distribution lines.

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